

Acoustic emission verification testing of Fluids and Combustion Facility flight racks conducted at Acoustical Testing Laboratory

The Glenn Research Center Acoustical Testing Laboratory (ATL) provides a comprehensive suite of acoustical services for developers of science experiments manifested for the International Space Station (ISS). Since the ATL's opening in September 2000, its primary customer has been the Fluids and Combustion Facility (FCF), a two-rack microgravity research facility developed at GRC. The ATL provided acoustic emissions testing of sound source components, subassemblies, and partially-populated racks, in support of FCF's low-noise design effort. The iterative design/test process enabled the FCF acoustics team to understand and continually track the acoustic emissions of components and subassemblies as they were successively incorporated into higher level hardware packages. This effort culminated in the final acoustic emission verification tests on the FCF Combustion Integrated Rack (CIR) and Fluids Integrated Rack (FIR) in the spring of 2005.

The primary objective of the CIR and FIR flight rack acoustic emission verification tests was to determine the acoustic emissions of the racks for purposes of comparison with the limits specified in NASA SSP 57000¹ for both continuous and intermittent acoustical noise. The secondary objective of these tests was to provide data to support test-correlated analytical acoustic models of the racks, which may be used to accurately assess the predicted acoustic emissions of CIR and FIR configurations after future on-orbit modifications.

The SSP 57000 requirements provided little guidance in the way of measurement methodology or measurement uncertainty. ATL staff selected the procedures and uncertainty estimates in ISO 11201² as the method for sound pressure level determination because ISO 11201 standardizes many of the elements of NASA SSP 57000. ATL's preparation for the rack-level acoustic emissions verification tests spanned a two-year period and involved the development of detailed procedures for testing in accordance with ISO 11201. This included the implementation of two stationary microphone arrays, which represented the optimum accommodation of the maximum number of microphones and data channels available, the desired level of measurement accuracy, and the total amount of testing time available.

The ATL's ISO 17025-compliant quality system is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP Code 200557-0) for sound power level testing per ISO 3744 and ANSI S12.54 and is the only NVLAP-accredited acoustical testing laboratory agency-wide. In December 2004, the ATL became the only laboratory in the United States to receive accreditation for ISO 11201.

References:

¹ *Pressurized Payload Interface Requirements Document, International Space Station, National Aeronautics and Space Administration, SSP 57000, Revision G, (Sept 4, 2003).*

² *Acoustics - Noise emitted by machinery and equipment – Measurement of emission sound pressure levels at a work station and at other specified positions – Engineering*

method in an essentially free field over a reflecting plane, International Standard ISO 11201:1995; First Edition 1995-12-15.